

CLEAN VERSION

IN THE CLAIMS:

Please cancel claims 1-50 without prejudice. Such claims are being prosecuted in the parent application.

Please add the following new claims 51-76 as follows:

51. (New) An electronic fluid exchanging apparatus for servicing a vehicular subsystem having a fluid reservoir containing a used fluid, said apparatus comprising:

a supply tank for supplying a fresh fluid;

a used fluid tank for collecting said used fluid from said fluid reservoir;

a first sensor in communication with said supply tank and being operable to generate a supply fluid level signal corresponding to an upper fresh fluid level in said supply tank when in use;

a second sensor in communication with said used fluid tank and being operable to generate a used fluid level signal corresponding to an upper used fluid level in said used fluid tank when in use;

at least one of said sensors including a capacitor element responsive to respective said upper fluid level and operable to generate said respective fluid level signal;

a fluid flow rate control device adapted to be coupled between said fluid reservoir and said tanks and selectively operable to direct fluid therebetween; and

a processing unit coupled to said sensors and said fluid flow rate control device, said processing unit being programmed to, upon coupling said fluid flow rate control device to said fluid reservoir and said tanks and initiating fluid flow therebetween, obtain

a fluid level signal from said sensor including a capacitor element and, based on said obtained fluid level signal, transmit a control signal to said fluid flow rate control device to regulate a flow rate of at least one of said fluids between said fluid reservoir and said tanks.

52. (New) The electronic fluid exchanging apparatus as set forth in claim 51 wherein:

said first sensor includes said capacitor element responsive to said upper fresh fluid level and operable to generate said fresh fluid level signal.

53. (New) The electronic fluid exchanging apparatus as set forth in claim 51 wherein:

said second sensor includes said capacitor element responsive to said upper used fluid level and operable to generate said used fluid level signal.

54. (New) The electronic fluid exchanging apparatus as set forth in claim 51 wherein:

said first sensor includes a capacitor element responsive to said upper fresh fluid level and operable to generate said fresh fluid level signal; and

said second sensor includes a capacitor element responsive to said upper used fluid level and operable to generate said used fluid level signal.

55. (New) The electronic fluid exchanging apparatus as set forth in claim 54 wherein:

said processing unit is programmed to obtain said fresh fluid level signal from said first sensor and said used fluid level signal from said second sensor and, based on a comparison of said fluid level signals, transmit said command signal to said fluid flow rate control device.

56. (New) The electronic fluid exchanging apparatus as set forth in claim 51 wherein:

said first sensor includes a coaxial capacitor probe element extending into said fresh fluid tank from an upper housing, said housing including a control circuit operable to generate an outgoing voltage signal across said probe element at a predetermined frequency and measure an incoming voltage frequency from said probe element to generate said upper fresh fluid level signal.

57. (New) The electronic fluid exchanging apparatus as set forth in claim 51 wherein:

said second sensor includes a coaxial capacitor probe element extending into said used fluid tank from an upper housing, said housing including a control circuit operable to generate an outgoing voltage signal across said probe element at a predetermined frequency and measure an incoming voltage frequency from said probe element to generate said upper used fluid level signal.

58. (New) The electronic fluid exchanging apparatus as set forth in claim 51 wherein:

said first and second sensors are top mounted to each respective said tank and include elongated probes extending into the respective said tanks and operable to sense a capacitance change along a length of respective said probes.

59. (New) The electronic fluid exchanging apparatus as set forth in claim 51 wherein:

said fluid flow rate control device is a pump.

60. (New) The electronic fluid exchanging apparatus as set forth in claim 51 wherein:

said fluid flow rate control device is a solenoid valve.

61. (New) The electronic fluid exchanging apparatus as set forth in claim 51 wherein:

said fluid flow rate control device includes a manifold defining a fluid circuit interposed between said tanks and said reservoir, said manifold including at least one fluid control component selectively operable to direct at least one of said fluids through said fluid circuit.

62. (New) The electronic fluid exchanging apparatus as set forth in claim 51

wherein:

said fluid flow rate control device is a pump and a set of valves disposed in a fluid transfer circuit housed in a manifold.

63. (New) The electronic fluid exchanging apparatus as set forth in claim 56

wherein:

said control circuit includes an analog to digital converter operable to transmit a digital supply fluid level signal corresponding to said supply fluid level signal obtained from said capacitor element to said processing unit.

64. (New) The electronic fluid exchanging apparatus as set forth in claim 51

wherein:

said processing unit is programmed to compute a substantially real time fluid quantity for each of said tanks using a set of stored tank geometry data and said fluid level signals received from said sensors.

65. (New) The electronic fluid exchanging apparatus as set forth in claim 64

wherein:

said processing units is programmed to compare relative changes in said fluid quantities from each said tank and based upon said comparison, transmit a command signal to selectively operate said fluid flow rate control device.

66. (New) The electronic fluid exchanging apparatus as set forth in claim 64
wherein:

said fluid rate control device is selectively operable to balance an incoming fluid rate into said used fluid collection tank with an outgoing fluid rate from said supply tank based on said fluid level signals.

67. (New) The electronic fluid exchanging apparatus as set forth in claim 51
wherein:

said processing unit being programmed to periodically obtain said fluid level signals from said sensors at predetermined time intervals.

68. (New) The electronic fluid exchanging apparatus as set forth in claim 51
wherein:

said processing unit being programmed to substantially continuously obtain said fluid level signals from said sensors.

69. (New) The electronic fluid exchanging apparatus as set forth in claim 51
wherein:

said fluid flow rate control device is a pump, said pump being responsive to a command signal from said processing unit based on a comparison of said used fluid level signal and said supply fluid level signal.

70. (New) The electronic fluid exchanging apparatus as set forth in claim 56 wherein:

said probe element is integrated into said control circuit and said control circuit measures a time interval between issuance of said outgoing voltage frequency and a change in said incoming voltage frequency, said time interval corresponding to a length along said probe element at a point where a dielectric medium in said probe element changes from oil to air.

71. (New) The electronic fluid exchanging apparatus as set forth in claim 56 wherein:

said sensors are mounted to a bracket attached to an upper surface of at least one of said tanks, each sensor including a probe element extending throughout a height of respective said tank.

72. (New) An electronic fluid exchanging apparatus for servicing a vehicular subsystem having a fluid reservoir containing a used fluid, said apparatus comprising:

a supply tank for supplying a fresh fluid;

a used fluid tank for collecting said used fluid from said reservoir;

a first sensing means for sensing a change in capacitance at an upper level of said fresh fluid in said supply tank to generate a fresh fluid level height signal;

a second sensing means for sensing a change in capacitance at an upper level of said used fluid in said used fluid tank to generate a supply fluid level height signal;

fluid flow rate control means coupled between said fluid reservoir and said tanks for selectively directing fluid therebetween; and

a processing unit coupled to said first and second sensing means and said fluid flow rate control means, said processing unit being programmed to, upon coupling said fluid flow rate control means to said fluid reservoir and said tank and initiating fluid flow therebetween, selectively transmit a control signal to said fluid flow rate control means to regulate a flow rate of at least one of said fluids between said fluid reservoir and said tanks based on said fluid level height signals received from said first and second sensing means.

73. (New) An electronic fluid exchanging apparatus for servicing a vehicular subsystem having a fluid reservoir with a used fluid and an inlet port and an outlet port and a pump for circulating fluid therebetween, said apparatus comprising:

a manifold defining a first manifold port for coupling to said inlet port, a second manifold port for coupling to said outlet port, a fresh fluid manifold port, a used fluid manifold port, and a fluid transfer circuit therebetween;

a supply tank for supplying a predetermined amount of new fluid to said new fluid manifold port;

a used fluid collection tank for receiving a predetermined amount of said used fluid from said used fluid manifold port;

a first sensor operable to sense an upper level of said new fluid in said supply tank;

a second sensor operable to sense an upper level of said used fluid in said collection tank;

at least one of said sensors including an elongated sensor probe of a predetermined length extending into a respective said tank and operable to measure a capacitance change corresponding to an upper level of respective said fluid along a length of said probe and further being operable transmit a fluid level signal proportional to said length of said probe where a capacitance change is sensed;

a fluid control device in communication with said fluid transfer circuit for directing fluid through said fluid transfer circuit between said ports, said fluid control device being selectively operable upon receipt of a command signal;

a processing unit in communication with said sensors and said fluid control device, said processing unit being programmed to monitor said first and second sensors to obtain a new fluid level signal and a used fluid level signal and further being programmed to transmit a command signal to said fluid control device to selectively control a flow rate of at least one of said fluids passing through said fluid transfer circuit; and

whereby, upon coupling said first manifold port to said inlet port and said second manifold port to said outlet port, said subsystem pump may be activated and said fluid control device selectively operated to direct at least one fluid through said fluid transfer circuit at a controlled flow rate based upon at least one of said fluid level signals.

74. (New) An electronic fluid exchanging apparatus for servicing a vehicular subsystem having a fluid reservoir containing a used fluid, said apparatus comprising:

a supply tank for supplying a fresh fluid;

a sensing unit in communication with said supply tank, said sensing unit being operable to sense a change in capacitance corresponding to an upper level of said fresh fluid to generate an upper level fresh fluid signal;

a fluid flow rate control device coupled between said fluid reservoir and said tanks and selectively operable to direct fluid therebetween; and

a processing unit coupled to said sensing unit and said fluid flow rate control device, said processing unit being programmed to periodically monitor said sensing unit to obtain said upper level fresh fluid signal and based on said fluid signal transmit a control signal to said fluid flow rate control device to regulate a flow rate of fluid being transferred between said supply tank and said reservoir.

75. (New) An electronic fluid exchanging apparatus for servicing a vehicular subsystem having a fluid reservoir containing a used fluid, said apparatus comprising:

a used fluid tank for collecting used fluid from said reservoir;

a used fluid sensing unit in communication with said used fluid tank, said used fluid sensing unit being operable to sense a change in capacitance corresponding to an upper level of said used fluid to generate an upper level used fluid signal;

a fluid flow rate control device coupled between said fluid reservoir and said tanks and selectively operable to direct fluid therebetween; and

a processing unit coupled to said sensing unit and said fluid flow rate control device, said processing unit being programmed to periodically monitor said used fluid sensing unit to obtain said upper level used fluid signal and based on said fluid signal transmit a control signal to said fluid flow rate control device to regulate a flow rate of used fluid being transferred between said used fluid tank and said reservoir.

76. (New) A method for controlling incoming and outgoing fluid flow rates between a fluid exchanging apparatus and a vehicular subsystem having a fluid reservoir containing a used fluid, said method comprising:

providing a fresh fluid supply tank with a predetermined quantity of a fresh fluid;

providing a used fluid collection tank;

providing a sensing unit including a first sensor probe extending into said fresh fluid supply tank and a second sensor probe extending into said used fluid collection tank, each of said probes being responsive to a capacitance change corresponding to an upper level of a fluid within respective said tanks and operable to generate a fluid level signal proportional to respective said upper fluid levels;

providing a fluid flow rate control device adapted to be coupled between said fluid reservoir and said tanks and selectively operable to direct fluid therebetween;

providing a processing unit coupled to said sensing unit and said fluid flow rate control device, said processing unit being programmed to transmit a command signal to said fluid flow rate control device based upon said fluid level signals obtained from said sensing unit;

coupling said fluid rate control device to said fluid reservoir and said tanks;

actuating said fluid flow rate control device to begin directing fluid between said reservoir and at least one of said tanks; and

actuating said processing unit to monitor said sensing unit to obtain said fluid level signals and, based upon said fluid level signals, transmit a command signal to said fluid flow rate control device to regulate a fluid flow rate of at least one of said fluids.